MIL07

Via Lombardia 1, Siziano, MI, Italy

STACK INFRASTRUCTURE

Report - Statement of Requirements - Rainwater and Wastewater

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1. EXCAVATIONS AND BACKFILLING

1.1. Excavation: definitions and general requirements

Excavations are the work required for:

- topsoil removal;
- surface levelling;
- excavations and backfilling;
- construction of the roadway, parking areas and related spaces, in accordance with the design drawings and any specific instructions issued by the Site Manger during the project execution;
- the formation of the excavation for the paving of the roadbed;
- excavations for the preparation of foundations;
- excavations for the construction of pipe/conduits.

In addition, all large section cuts easily accessible, by means of a ramp, to both the excavation means and the material transport means, fully loaded, shall also be considered as earthworks.

Excavations for any work, by hand or by mechanical equipment, shall be carried out according to the design drawings and the geological and geotechnical report, as well as according to the special prescriptions that will be given at the executive act by the Site Manager.

All operations must be performed in accordance with the specifications set out in the Safety and Coordination Plan and the operational plan written by the contractor and, if necessary, other documentation of mandatory value and the indications received from the Safety Coordinator during the execution phase.

In the execution of the excavations, the Contractor shall proceed in such a way as to prevent landslides and collapses, if necessary, by means of shoring or yawing, and shall remain fully responsible for any damage to persons and works and shall also be obliged to provide for the removal of the landslides at its own expense.

The operations necessary for the safety of workers and/or third parties and the cost of the armour are always included in the work, even if the material used cannot be recovered.

The Contractor shall be responsible for the strength and stability of any reinforcements supporting the excavations and shall be obliged to replace any weak parts.

The excavations will be surrounded by defensive fencing for the safety of pedestrians and vehicles; any access panels to the excavation bottom must be kept free of nails, chipping or other overhangs that may be dangerous.

The contractor covers the costs of deviating rainwater or, alternatively, pumping it.

The Contractor will be responsible of taking the minimum possible space away from the viability, take the necessary measures to make the transit of vehicles and pedestrians safe, as well as prepare all the signals required by the regulations in force.

If any structure or item in the area around the excavations should present lesions or suggest that it may be formed because of the work, it shall be the contractor's obligation to conduct a thorough assessment of its condition in contradiction with the properties concerned, providing it with suitable photographic documentation and installing, if necessary, control indicators.

Excavated material must be deposited in a place specified by the Site Manger and then taken back in due time. In any case, the deposited materials shall not cause damage to the works, to public or private property and to the free flow of surface water.

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The Site Manager reserves the right to request the removal, at contractor's expense, of materials deposited in disregard of the above provisions. The works are always intended to include all costs necessary to provide the completed work, including loading, transport and storage of materials within the site according to the Site Manager.

If excavated materials should eventually be used, they must be deposited within the limits of the site lot, with the prior consent of the Site Manager, and then taken back in due time.

By excavation of embankment is meant the excavation necessary for the levelling and arrangement of the ground on which the structures will be built, for the arrangement of yards, for the formation of support surfaces for foundation rafts, etc., and in general any excavation with a large section that allows the use of normal mechanical equipment or where it is possible that allows the removal of the excavated materials with the formation of temporary ramps, which will be executed at contractor's expense.

Therefore, excavations below ground-level will also be considered as embankment excavations when the excavations cover the above-mentioned features, such as, for example, the construction of the subgrade below the road paving.

The excavation shall also be carried out in the presence of water and the excavated materials, unless otherwise indicated by the Site Manager, shall be transported to landfill or accumulated in areas indicated by the Site Manage, for later use. In the latter case, it will be the responsibility of the Contractor to make sure that the soil is free from any vegetative material or in general any material that is alien to its intended use.

1.1.1. Excavation for pipes

The term "excavation for pipes and channels" is used to describe the excavation of recessed and narrow section excavations carried out under the earthworks level designed to embed channels, sewers, pipes and manholes. Excavations for the laying of pipes shall be of such cross-section and width as to facilitate any movement necessary for the laying of pipes, the execution of joints, tests and inspections and, if necessary, the dismantling of pre-existing pipelines. The bottom of open excavations for the laying of pipes must be well levelled and with the prescribed slopes. No overhangs or dips of more than 5 cm from the design level will be permitted. At the points corresponding to the pipe joints and when laying the pipes, wide and deep niches must be excavated, if necessary, so as to allow the joints between the pipes to be perfectly executed and inspections to be conducted during the tests. The progress of the excavations shall be matched to the effective progress of the pipe supplies. Any discontinuity in the rate of supply may not, however, in any case, give the Contractor the right to request compensation, higher than that set by contract, and to vary the progress of its work in a way adequate to the supply of the pipeline. The Site Manager reserves the right to determine from time to time the length of the excavation to be opened.

1.1.2. Reprofiling of banks for the construction of basins

Reprofiling must be carried as follows: along the banks of basins indicated on the project drawings, and after all the operations necessary for the removal of shrubs and trees where they exist, the removal of the existing topsoil to a minimum thickness of 20 cm in the case of soil on site that is not subject to other work, the removal of roots where they exist, the filling in of the holes produced, the reprofiling of the slope in accordance with the project drawings and the re-growing of the surfaces.

The work must ensure the complete elimination not only of vegetation but also of all root systems, to minimise the possibility of new plants growing.

Garden soil and riverbank soil resulting from the above-mentioned operations will be reused in backfill activities after characterization. If it is characterized as waste, it will be removed from the site area and transported as waste to the landfill or to a specific site indicated by the Site Manager.

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The Contractor must ensure that the hydraulic section does not reduce with respect to the actual condition in the case of bank reprofiling.

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2. EARTHWORKS

The earthworks include watering, levelling and compacting of ground (sub-base) under base coarse to min 95% according to Field Density Test and on-site topographical tests of works to verify a final altitude profile slope below 5%.

Activities will consist in:

- construction staking and site layout on the base of the coordinate points reported in the project drawing;
- topographical checks to verify the slope; include on site topographical tests of works to verify a final altitude profile slope below 5%;
- earthwork of excavation, made by a bulldozers/grader machine in all types of soil/rock, even in the presence of water, excluding rock and boulders exceeding 0.75 m³.
    - Rate of Excavation shall include:
        - excavation to any depth, in any shape, in any type of soil;
        - levelling, ramming, trimming, grading excavation bottoms, reprofiling, watering and compaction;
        - planking and strutting.
- Earthwork of Backfilling with mechanical compaction of the ground, made by a bulldozers/grader machine in all types of soil/rock, even in the presence of water, excluding rock and boulders exceeding 0.75 m³. The material must be compacted at 95% of the Proctor modified density. The material must be watered and compacted and every 30 cm.
    - Includes watering, levelling and compacting of ground (sub-base) under base coarse to min 95% according to Field Density Test.
- Topographical tests of works to verify a final altitude profile slope below 5%.
- Depending on the equipment 4 to 12 passes are required at each point of the carriageway. Passes should overlap each other. Start rolling from the edge and work towards the centreline, then repeat on the other side. The Site Supervisor reserves the right to request, on behalf of the Company, the carrying out of a load test on a plate. To be referred to the quality control plan of client and supplier of signs Site Supervisor and Site Manager.

2.1. Material from excavation on site

For the execution of the backfills, materials from the excavations on site will commonly be used or, if indicated in the drawings and/or requested by the Site Manager, materials from quarries will be used. For the execution of the embankments will generally be used, unless otherwise specified by the Site Manager, materials that are not coherent (sand, gravel or crushed stone) or coherent (clayey silt, clays) also coming from both site excavations and approved quarries. All materials used will be previously approved by the Site Manager.

2.2. Material from quarry: material characteristics

With reference to the classification contained in the CNR UNI 10006 standards, the soils to be used will be sandy clays (class A6), sandy silts (class A4) and mixed sand and clay gravel (classes A2-4 and A2-6); the soils belonging to classes A4 and A6 must have a minimum sand content of 15%, while those belonging to classes A2-4 and A2-6 must have a clay content between 20% and 30%.Organic matter and clean sand must not be used.

The material used shall have a dry weight by volume of 95% of the dry volume weight obtained in the Proctor normal compaction test with a tolerance of +/-1%; the corresponding humidity shall have values between +/-2% of the optimum humidity obtained in the above compaction test. Once the moisture content has also been defined, it must be kept constant with a tolerance of +/-1%. After correction and mixing, if necessary, the material must have the following characteristics:

1. The aggregate must not be larger than 71 mm in size or flattened, elongated or lenticular;

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2. Granulometry included in the following mesh and having a continuous and uniform flow virtually in agreement with that of the boundary curves:
   Sieve and sieve series UN Mixture by total % by weight
   Sieve 71 100;
   Sieve 40 75/100;
   Sieve 25 60/87;
   Sieve 10 35/67;
   Sieve 5 25/55;
   Sieve 2 15/40;
   Sieve 0,4 7/22;
   Sieve 0,075 2/10;
3. Ratio between sieve passerby 0.0075 and sieve passerby 0.4 less than 2/3;
4. Loss in weight at the Los Angeles test on individual sizes less than 30%;
5. Equivalent in sand measured on the 4 ASTM sieve throughput fraction between 25 and 65. The upper limit of the sand equivalent (65) may be varied by the Site Manager according to the origin and characteristics of the material. For all materials with sand equivalent between 25 and 35, the Site Manager will in any case require (even if the mixture contains more than 60% by weight of crushed elements) the verification of the CBR bearing capacity index referred to in paragraph 6 below;
6. CBR bearing capacity index after 4 days of soaking in water (performed on the material passing through sieve 25) not less than 50. It is also required that this condition is verified for a range of +2% compared to the optimum compaction humidity.

If the mixtures contain more than 60% by weight of sharp-edged crushed elements, acceptance will be based only on the characteristics indicated in paragraphs 1), 2), 4), 5) above, except in the case mentioned in paragraph 5) where the mixture has a sand equivalent between 25 and 35.

2.3. Material tests

The tests on the materials were divided into qualification tests, acceptance tests during construction and final acceptance tests.

The qualification tests make it possible to check whether the material of a particular slot or excavation is suitable for use in accordance with the described requirements.

Acceptance tests during construction allow you to check whether the material supplied on site is compliant with the project requirements and corresponds to what was verified during the qualification phase.

The final acceptance tests make it possible to verify that the methods of installation and compaction adopted by the company have made it possible to achieve the requisites envisaged in the project.

The burden of the performance of the qualification tests is to be considered fully borne by the Contractor.

The Site Manager reserves the right to take samples at the source in contradictory to be analysed by an authorized laboratory chosen by mutual agreement with the company; to these tests, at the expense of the Contracting Authority, we will refer in case of any doubts or objections.

During the phases of execution of the works, the Site Manager will have the right to carry out "shipyard tests" through its own personnel to verify the compliance of some physical parameters such as the moisture content of the material or the degree of compaction achieved: these checks will be decisive for the continuation of the work. The company is required to pay for assistance and collaboration, provided that these tests are at the expense of the contracting authority and that the company can use at its own expense another authorized laboratory in the event of a dispute.

During the phases of execution of the works it is foreseen the eventual preparation (at the expense of the company) of "test fields" to define the methods of laying and compacting (number of passes,

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speed, weight of the rollers, possible need to dry / dampen the material, etc.) to guarantee the achievement of the design requirements of the different materials envisaged. The number, the dimensions and the modalities of the "fields" will be defined by the Site Supervisor that reserves the right to also prescribe a suitable number of tests for the control of project parameters. The tests are to be considered to be borne by the Contracting Company.

In the testing phase the Site Supervisor reserves the right to carry out "additional tests", in addition to those routinely, to verify, in cases of uncertainty, the compliance of the works carried out: these tests will be borne by the contracting authority if the full compliance of the completed work is confirmed to the project requirements; in cases of non-compliance with the design features, the contractor will be required to pay for such additional tests, in addition to any damage attributable to the non-compliance of the work done.

2.4. Qualifications and acceptance tests

For each homogeneous batch of material supplied on site, at least the complete classification tests including:

- wet granulometry (non-aerometry);
- Atterberg limits (if possible, to run them);
- modified proctor type compaction test.

For each homogeneous batch of material, before the laying of the same, the Site Manager reserves the right to request, at the expense of the Contractor if supplied by it, a chemical analysis carried out because of which according to international regulations.

2.5. Levelling activity

First of all it is necessary to clear up the site by cleaning and grubbing for removal of rank, vegetation, shrubs, grass including roots, debris, and unusable materials.

Any rocks and boulders exceed 0,75 m^3 must be removed and relocated to approved areas within the site.

The soil must be properly flattened before the installation of the plant. Earth-moving machines such as the loader, the dump truck, the bulldozer, the backhoe and the grader can be used.

The grader with a long blade, also commonly referred to as a road grader or a motor grader, creates a flat surface during the grading process.

The areas destined to storage area and internal roads must be compacted before backfilling.

2.6. Embenkment backfilling material

For the formation of backfilling works, i.e. to fill in the voids between the excavations and the structures, or to be placed on works/buildings, and up to the levels prescribed by the Site Manager, all materials from excavations of any kind carried out for this site shall be used in general and, except for the following, until they are completely exhausted, as they are available and suitable, in the opinion of the Site Manager, for the formation of embankments.

When all or part of the above materials are lacking, the materials required shall be taken from wherever the Contractor believes it is convenient, provided that the materials are recognised as suitable by the Site Manager.

Loose or gravelly materials shall always be used, it being absolutely forbidden to use clayey materials and, in general, all those which soften and expand by absorbing water, generating pressure.

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In the formation of the backfills and fillings, every care must be taken to ensure that they are carried out in horizontal layers of equal height, while at the same time arranging the well chopped materials with the greatest regularity and precaution, to load the works evenly on all sides and to avoid the strain that could result from a wrongly distributed load.

Substances transported in embankments or backfills by vehicles or other operating machinery may not be discharged directly against the works or pipeline but must be deposited near them to be taken up again when the backfills are formed.

For such movements of materials, the materials themselves must always be staked, to be carried out according to the prescriptions that will be indicated by the Site Manager.

All repairs or reconstructions that may become necessary due to failure or imperfect compliance with the instructions of this paragraph shall be at contractor's complete expense. It is the Contractor's duty, excluding any compensation, to give the embankments, during their construction, the larger dimensions required for the settlement of the land, so that at the time of testing the embankments carried out are not smaller than those ordered.

The use of aggregates obtained from the recovery of materials coming from demolitions, constructions and excavations is allowed after treatment in special recycling plants authorized according to current legislation.

Also, for this material the declaration of origin and characterization must be previously provided to the Site Manager.

The faculty, after having examined the material and possibly the production yard, is allowed to accept the proposed material or not.

2.7. Laying mode activity

The material will be laid in layers with thickness between 10 and 20 cm and must not show segregation phenomena, the environmental conditions during the operations must be stable and not have excess moisture or frost. Any addition of water must be carried out with suitable sprayers. The compaction will be performed with vibrating or vibrating rubber rollers according to the instructions of the Works Management and until obtaining, for each layer, a density of not less than 95% of the density indicated by the modified AASHO test, or an MD equal to 80 N / mmq (about 800 kgf / sq. cm) according to the CNR standards for the plate test. Including every other burden and execution modality to give the complete work and performed to perfection.

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3. PIPELINES

This chapter outlines the technical specifications for the following pipes included in the project:

DESCRIPTION	ITEM SPECIFICATION
HDPE pressure underground pipelines	DP.PST
HDPE no-pressure underground pipelines with a corrugated external wall and smooth internal wall	RW.PI.nn, WW.PI.nn
Smooth HDPE no-pressure underground pipelines	WW.PI.nn
HDPE no-pressure perforated pipes underground pipelines with a corrugated external wall and smooth internal wall	DP.TR1, DP.TR2

3.1. HDPE pressure underground pipelines (DT.S1)

PEAD PE100 (high density polyethylene) high performance (RC) pipes must respect the UNI EN 12201 standard for pressure water flow, consisting of pipes of any length, fittings and special pieces connected by means of quick couplings, head-head welds or electro-weldable sleeves.

The pipes must be indelibly stamped with the IIP mark, the initials of the raw material and all other information required by the UNI EN 1622 standard. The project foresees HDPE pipes with smooth double wall stiffness in class PN 10. Diameters will be sized in the next design phase.

The manufacturer must be certified in accordance with ISO 9001 and Environmental Certification in accordance with ISO 14001 issued by an accredited body.

Producers who, in addition to the Italian UNI-IIP-Italy certification, are in possession of quality certifications issued and recognized by other bodies in European countries will also be welcome.

The requirements of the raw material must comply with the requirements of EN 12201-1, but with higher performance characteristics, able to prevent slow expansion of the fracture caused by scratches or surface carvings.

The raw material to be used for the extrusion of the tube shall be produced by leading and well-known European resin producers and derived exclusively from the polymerization, or copolymerization, of ethylene gas.

The polymer (PE) shall be stabilised and added by the manufacturer of the raw material with appropriate additives uniformly spread in the mass in grains

form.

The additives used (antioxidants, stabilizers, lubricants, pigment) will have to be dosed and added to the base resin by the raw material manufacturer during the compound manufacturing phase (finished resin) and will be designed to improve performance during the drawing and injection phases, and to provide the necessary resistance to atmospheric agents and ageing of the finished product.

The raw materials used must be certified and approved by a third party accredited at national (Italian Plastics Institute) or European level.

The use is not permitted, even if partial and/or temporary, of:

- compound and/or base material obtained by regeneration of recovery polymers even if selected or fracture from first extrusion.
- compound and/or base material obtained by mastering neutral raw material (neutral polyethylene added by the pipe manufacturer with additives);

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- batch of compounds indicated by the same manufacturer as batches characterized by parameters, such as Melt Index, density, residual moisture, not conforming to the standard product profile;
- pre-extrusion blending between chemically and physically compatible compounds but coming from different producers or different raw materials even from the same producer.

The characteristics of the pipe compound should be:

PARAMETER	THRESHOLD
MRS (Minimum Required Strength) (ISO/TR 9080)	≥ 10 MPa
RCP (Rapid Crack Propagation) SDR 17, 0°C (ISO 13477)	Press min arrest 10,0 bar
(Slow Crack Growth – Notch Pipe Test T=80°C; t=165h; Press = 9,2 bar (EN ISO 13479)	≥ 5000 h
Specific resistance to internal pressure σ = 4 MPa, in 80°C bath of 2% surface-active agent solution (Arkopal) with concentrated load on the tube (Point Load Test)	> 8760 h
O.I.T. (T=200°C) - (UNI EN 728)	≥ 50 min
Melt Index (5 kg T=190°C t=10min.) - (ISO 1133)	range 0.2 e 0.5 g/10min

The characteristics of the pipes must comply with the requirements of UNI EN12201-2, and have values higher than the minima laid down according to the table below, in order to guarantee the adequate level of reliability and safety of the pipeline:

CHARACTERISTCS AND MINIMUM STANDARD VALUES	TEST METHOD
Specific resistance to internal pressure 20 °C / 100h / σ = 12.4 Mpa 80 °C / 165h / σ = 5.4 Mpa 80 °C / 1000h / σ = 5.0 Mpa	UNI EN ISO 1167
Elongation at break ≥ 350 %	UNI EN ISO 6259
MFR fluidity index variation of less than 20% as a result of processing. Test temperature 190 °C, Load 5 kg, Test time = 10 min.	UNI EN ISO 1133
Oxidation induction time OIT ≥ 20 min a 200°	UNI EN 728
Full notch creep test accelerated method ACT 90° / NM5 2% / 4 N/mm2	PAS 1075
Resistance to slow creep growth SGC – notch pipe test - NPT 80 °C / σ = 4,6 MPa	ISO 13479

The reference marks will be made by chemical or mechanical impression, hot, indelible and must comply with the requirements of EN 12201.

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3.2. Corrugated HDPE no – pressure underground pipelines (SAO, SAB, SPP)

Supply and installation of high-density polyethylene (HDPE) piping for underground, non-pressurized discharge pipes, made by continuous co-extrusion of two sides, the internal one must be smooth and black coloured, the external one corrugated and black coloured. The system (pipe + junction) must be fully compliant with UNI EN 13476-1 and UNI EN 13476-3 and certified with product quality mark by an accredited third-party certifying body, nominal outside diameter DN/OD as indicated by design drawings, annular stiffness class SN 8 measured according to EN ISO 9969. The pipe must be produced by a company operating under a production quality system that complies with UNI EN ISO 9001/2008 and environmental management system UNI EN ISO 14001/2004.

The pipes must be equipped with a socket or external sleeve joint with relative EPDM seals in compliance with EN 681-1, to be positioned in the first groove between two successive corrugations of the end of the pipe to be inserted in the socket.

The pipe is marked in accordance with UNI EN 13476-1 and UNI EN 13476-3 and must be exhibited:

- Test certificates for annular flexibility according to UNI EN 13476-3 with the test method described in UNI EN 1446;
- Environmental quality certification (UNI EN ISO 14001:2004);
- Certification of production under company quality regime (UNI EN ISO 9001:2008);
- Test certification of the hydraulic sealing of the joints according to UNI EN 13476-3 with the test method described in EN 1277;
- Certification of abrasion resistance tested according to DIN EN 295-3;
- Product certification according to UNI EN 13476-3 issued by an accredited third party.

Aspect	Marking or symbols	Legibility [a]
Number of this document	EN 13476-2	a
Diameter series, nominal size/actual guaranteed min. inside diameter [b] for:		
DN/OD series	DN 250 [c]	a
DN/ID series	DN/ID 225 [c]	a
Manufacturer's name and/or trade mark	XXX	a
Stiffness class	e.g. SN 8	a
Ring flexibility	"RF20" (when applicable, see Annex I)	a
Material	Either PVC-U, PVC[d] , PP or PE	a
Application area code	"U" or "UD" as applicable	a
Manufacturer's information	[e]	a
Impact resistance – 10 °C	❄ (ice crystal) (when applicable, see Annex H)	b
Impact resistance + 23 °C	IMP 23 C (when applicable, see Annex G)	b
Close tolerance class [f]	CT	b

[a] Legibility codes
a denotes durable in use;
b denotes legible at least until the system is installed.

[b] Marking of the guaranteed minimum mean inside diameter is voluntary, but if marked it shall be as shown.

[c] If a component is designed for both DN/OD and DN/ID series, one of them may be marked on a label.

[d] PVC-U is preferred to PVC.

[e] Shall be given in clear figures or in a code providing traceability to the following details:
- production period year and month.
- production site if the manufacturer is producing in different sites, nationally and/or internationally.

[f] Only applicable for PP and PE pipes with CT spigots as specified in EN 1852-1 or EN 12666-1.

Proprietà del Materiale

Caratteristica	Condizioni	Valore tipico	UdM	Norma
Densità		>940	kg/m³	ISO 1183
Modulo elastico	(2 mm/min)	>800	Mpa	ISO 178
Resistenza all'urto (Charpy)	23 °C	> 17	kJ/m²	ISO 179/1e

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Proprietà del Manufatto

Caratteristica	Valore tipico o Descrizione	UdM	Norma
Impiego	Condotte di scarico interrate non in pressione	-	-
Resistenza allo schiacciamento	≥SN dichiarato	kN/m²	Norma EN ISO 9969
Costituzione	Stabilizzato ai raggi UV con garanzia 1 anno dalla data di produzione riportata sul tubo.		-
Limiti d'impiego	-40 °C / +60	°C	-
Imballo	6	m	-
Accessori	Bicchiere a corredo / manicotto di giunzione e guarnizione	-	-
Installazione	Sotterranea in trincea.	-	-

The project includes the following types of corrugated HDPE pipelines:

- HDPE pipes SN8 kN/m2 De 250 mm - Di 218 mm;
- HDPE pipes SN8 kN/m2 De 284 mm - Di 250 mm;
- HDPE pipes SN8 kN/m2 De 315 mm - Di 272 mm;
- HDPE pipes SN8 kN/m2 De 350 mm - Di 300 mm;
- HDPE pipes SN8 kN/m2 De 400 mm - Di 347 mm;
- HDPE pipes SN8 kN/m2 De 468 mm - Di 400 mm;
- HDPE pipes SN8 kN/m2 De 500 mm - Di 433 mm;
- HDPE pipes SN8 kN/m2 De 565 mm - Di 500 mm;
- HDPE pipes SN8 kN/m2 De 701 mm - Di 600 mm;

3.2.1. Properties Test

- Melt flow rate - Ref. ISO 1133: 1987 Condition 1T (Test parameter: 190°C / 5 Kg. / 10 min) on the extruded material and on the raw material of the two sides;
- density - Ref. ISO 1183 : 1987 - (Test temperature: 23° C) on the extruded material and on the raw material of the two sides;
- thermal stability (O.I.T) - Ref. Standard EN 728 - (Test temperature: 200° C) on the raw material of the two sides;
- smoke black content - Ref. ASTM D 1603 standard - (Test parameters: temp. 600° C in nitrogen) on the raw material and on the extrusion of the outer side;
- oven test - Ref. ISO 12091 standard - (Test temperature: 110° C; test time: 30 min.) on the finished product.

3.2.2. Mechanical Tests

- Impact test - Ref. Standard: EN 744 on the finished product - Annular flexibility test - Ref. Standard: UNI EN 1446;
- ring stiffness test - Ref. Standard: EN ISO 9969;
- determination of the plastic creep ratio ("creep") - Ref. Standard: EN ISO 9967;
- hydraulic tightness test - Ref. UNI EN 1277 standard.

3.2.3. Conformity Test

- Visual inspection - Ref. Standard UNI ISO 4582 par. 3 and 4;
- marking - The tube is marked every 2 metres with the correct, legible, longitudinal ink code;
- SN calculation - Ref. EN ISO 9969 standard;
- dimensions - Average external diameter (de), minimum internal diameter (dim) - Thicknesses e4 min./Thicknesses e5 - Ref. UNI EN 13476-3 (2009).

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INSTITUTION	LEGISLATION
IIP	UNI EN 13476-3: 2009
Bureau Veritas	UNI EN 13476-3: 2009

3.3. Smooth HDPE no – pressure underground pipelines (ANM)

Supply and installation of solid smooth-wall high-density polyethylene (HDPE) pipes, fully black in colour with coextruded brown stripes on the outer surface, for non-pressurized drainage systems, certified according to product standard UNI EN 12666-1, issued by a third-party certification body accredited according to UNI CEI EN ISO/IEC 17065. The pipe must bear the Made Green in Italy mark to communicate the environmental footprint of the products, according to the scheme established by the Ministry of the Environment and Energy Security, under Article 21, paragraph 1 of Law No. 221/2015. The marking should display both the product quality mark and the Made Green in Italy mark, as well as all other elements required by the relevant standard.

The pipe is marked in accordance with UNI EN 13476-1 and UNI EN 13476-3 and must be exhibited:

- test certificates for annular flexibility according to UNI EN 13476-3 with the test method described in UNI EN 1446;
- environmental quality certification (UNI EN ISO 14001:2004);
- certification of production under company quality regime (UNI EN ISO 9001:2008);
- test certification of the hydraulic sealing of the joints according to UNI EN 13476-3 with the test method described in EN 1277;
- certification of abrasion resistance tested according to DIN EN 295-3;
- product certification according to UNI EN 13476-3 issued by an accredited third party.

Aspect	Marking or symbols	Legibility [a]
Number of this document	EN 13476-2	a
Diameter series, nominal size/actual guaranteed min. inside diameter [b] for:		
DN/OD series	DN 250 [c]	a
DN/ID series	DN/ID 225 [c]	a
Manufacturer's name and/or trade mark	XXX	a
Stiffness class	e.g. SN 8	a
Ring flexibility	"RF20" (when applicable, see Annex I)	a
Material	Either PVC-U, PVC[d] , PP or PE	a
Application area code	"U" or "UD" as applicable	a
Manufacturer's information	[e]	a
Impact resistance – 10 °C	❄ (ice crystal) (when applicable, see Annex H)	b
Impact resistance + 23 °C	IMP 23 C (when applicable, see Annex G)	b
Close tolerance class [f]	CT	b

[a] Legibility codes
a denotes durable in use;
b denotes legible at least until the system is installed.

[b] Marking of the guaranteed minimum mean inside diameter is voluntary, but if marked it shall be as shown.

[c] If a component is designed for both DN/OD and DN/ID series, one of them may be marked on a label.

[d] PVC-U is preferred to PVC.

[e] Shall be given in clear figures or in a code providing traceability to the following details:
- production period year and month.
- production site if the manufacturer is producing in different sites, nationally and/or internationally.

[f] Only applicable for PP and PE pipes with CT spigots as specified in EN 1852-1 or EN 12666-1.

Proprietà del Materiale

Caratteristica	Condizioni	Valore tipico	UdM	Norma
Densità		>940	kg/m³	ISO 1183
Modulo elastico	(2 mm/min)	>800	Mpa	ISO 178
Resistenza all'urto (Charpy)	23 °C	> 17	kJ/m²	ISO 179/1e

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Proprietà del Manufatto

Caratteristica	Valore tipico o Descrizione	UdM	Norma
Impiego	Condotte di scarico interrate non in pressione	-	-
Resistenza allo schiacciamento	≥SN dichiarato	kN/m²	Norma EN ISO 9969
Costituzione	Stabilizzato ai raggi UV con garanzia 1 anno dalla data di produzione riportata sul tubo.		-
Limiti d'impiego	-40 °C / +60	°C	-
Imballo	6	m	-
Accessori	Bicchiere a corredo / manicotto di giunzione e guarnizione	-	-
Installazione	Sotterranea in trincea.	-	-

Smooth HDPE pipe diameters will be sized in the next design phase, based on detailed hydraulic calculations and confirmed flow data.

3.3.1. Properties Test

- Melt flow rate - Ref. ISO 1133: 1987 Condition 1T (Test parameter: 190°C / 5 Kg. / 10 min) on the extruded material and on the raw material of the two sides;
- density - Ref. ISO 1183 : 1987 - (Test temperature: 23° C) on the extruded material and on the raw material of the two sides;
- thermal stability (O.I.T) - Ref. Standard EN 728 - (Test temperature: 200° C) on the raw material of the two sides;
- smoke black content - Ref. ASTM D 1603 standard - (Test parameters: temp. 600° C in nitrogen) on the raw material and on the extrusion of the outer side;
- oven test - Ref. ISO 12091 standard - (Test temperature: 110° C; test time: 30 min.) on the finished product;

3.3.2. Mechanical Tests

- Impact test - Ref. Standard: EN 744 on the finished product - Annular flexibility test - Ref. Standard: UNI EN 1446;
- ring stiffness test - Ref. Standard: EN ISO 9969;
- determination of the plastic creep ratio ("creep") - Ref. Standard: EN ISO 9967;
- hydraulic tightness test - Ref. UNI EN 1277 standard.

3.3.3. Conformity Test

- Visual inspection - Ref. Standard UNI ISO 4582 par. 3 and 4;
- marking - The tube is marked every 2 metres with the correct, legible, longitudinal ink code;
- SN calculation - Ref. EN ISO 9969 standard;
- dimensions - Average external diameter (de), minimum internal diameter (dim) - Thicknesses e4 min./Thicknesses e5 - Ref. UNI EN 13476-3 (2009).

INSTITUTION	LEGISLATION
IIP	UNI EN 13476-3: 2009
Bureau Veritas	UNI EN 13476-3: 2009

3.4. Type of joint

The joints are made according to the following instructions, both for pipes and special parts:

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- carefully clean the parts to be joined making sure that they are intact; temporarily remove the gasket if it is present in its seat;
- insert the elastomeric gasket correctly in the first corrugation groove or in the appropriate seat where provided;
- lubricate the outer surface of the gasket and the inner surface of the socket or sleeve with a suitable lubricant (grease or silicone oil, Vaseline, etc.). Avoid the use of mineral oils or greases that would damage the gasket;
- insert the bar head into the socket until it stops; the perfect success of this operation depends exclusively on the precise alignment of the tubes and careful lubrication.

3.5. Geometric characteristcs

3.5.1. Diameter, thicknesses and tolerances

The pressure pipes must have the diameters and thicknesses, with the relative tolerances, in compliance with the values reported in UNI EN 12201 in the National Preamble page 1 and Chap. 6 Geometric Characteristics (page 4), elevations 1 and 2.

The non-pressure pipes must have the diameters with the relative tolerances, in compliance with the values reported in the following table:

Serie normalizzata sul diametro esterno DN/OD

Diametro nominale DN/OD (mm)	125	160	200	250	315	400	500	630	800	1000	1200
Diametro esterno minimo (mm)	124.3	159.1	198.8	248.5	313.2	397.6	497	626.2	795.2	994	1192.8
Diametro esterno massimo (mm)	125.4	160.5	200.6	250.8	316	401.2	501.5	631.9	802.4	1003	1203.6
Diametro interno minimo (mm)	105	134	167	209	263	335	418	527	669	837	1005
Diametro interno medio (mm)	107	137	172	218	272	347	433	535	678	852	1030
Spessore nella somma delle pareti $e4_{min}$ (mm)	1.1	1.2	1.4	1.7	1.9	2.3	2.8	3.3	4.1	5.0	5.0
Spessore della parete interna $e5_{min}$ (mm)	1.0	1.0	1.1	1.4	1.6	2.0	2.8	3.3	4.1	5.0	5.0
Rigidità anulare (SN) media	>4 >8	>4 >8	>4 >8	>4 >8	>4 >8	>4 >8	>4 >8	>4 >8	>4 >8	>4 >8	>4 >8
Stato delle superfici e finitura	Conf. UNI ISO4582										
N°berre per bancale	94	52	30	20	12	8	4	-	-	-	-
Barre da metri	6*	6*	6*	6*	6*	6*	6**	6**	6**	6**	6**
Materiale parete esterna	PE HD										
Materiale parete interna	PE HD										

* Compreso Bicchiere ** Escluso Bicchiere

Serie normalizzata sul diametro interno DN/ID

Diametro nominale DN/ID (mm)	250	300	400	500	600	800
Diametro interno minimo (mm)	245	294	392	490	588	785
Diametro esterno (mm)	284	350	468	565	701	935
Spessore nella somma delle pareti $e4_{min}$ (mm)	1.8	2	2.5	3.0	3.5	4.5
Spessore della parete interna $e5_{min}$ (mm)	1.5	1.7	2.3	3.0	3.5	4.5
Rigidità anulare (SN) media	>4 >8	>4 >8	>4 >8	>4 >8	>4 >8	>4 >8
Stato delle superfici e finitura	Conf. UNI ISO 4582					
Barre da metri	6.10	6.6	6.6	6.6	6	6
Materiale parete esterna	PE HD					
Materiale parete interna	PE HD					

3.5.2. Lengths

Pipes shall be supplied for the required De (external diameter) in bars with a total length of 6 m and/or 12 m, and, where applicable, in rolls of length depending on the external De and declared by the manufacturer.

3.5.3. Roll dimensions

The minimum internal diameter of the roll must not be less than 18 times the De of the tube, which must be rolled in a way that does not produce localized deformations.

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3.5.4. Fittings and special parts

The use of special parts is foreseen to realize bends (11,50°, 22,30°, 45°- 90° bends are not allowed), diameter reductions, T, T flanged, cups, ports, sleeves, etc., in PEAD PE100 PN16 performed in the factory or moulded, weldable by electrofusion or by head to head welding, produced by a manufacturer operating with ISO 9001 certified quality system issued by an accredited body and in possession of Environmental Management System certification in compliance with UNI EN ISO 14001.
The production of the fittings must be made in compliance with current regulations governing the transport of fluids under pressure, including the recent UNI EN 12201 and UNI EN 1555.
The supplier's laboratory must be equipped with all the necessary instruments to guarantee effective quality control of raw materials and finished products, in compliance with the main European standards, according to which the fittings are tested. Fittings and special pieces must be produced using certified Polyethylene, in compliance with current European standards, classified: MRS 10 = PE100 = Sigma 80 produced by world leader companies in the production of PE.
The fittings produced must be compatible and therefore can be joined with PE100RC pipes by means of head-to-head welding with thermal element for contact (UNI 10520) or by electrofusion welding (UNI 10521);
These fittings must be made by injection moulding, by assembly, in which case the welds must be carried out by Specialized Personnel with a Certificate of Qualification according to UNI 9737, or by mechanical processing.

The electro-weldable fittings must be approved for nominal pressures of 16 bar, although they must be coupled with PN 10 pipes.

On each item, suitably packed and sealed up to the moment of use, must be reported, in compliance with EN 12201 and EN 1555 standards, the bar code for reading with optical pen, the nominal diameter, the melting time and the cooling time, as well as the diameter, the type of material, the production batch number and the standards and certification markntros: the successful outcome of an electrofusion joint depends on compliance with the procedures and the correct use of the alignment and positioning devices.

3.6. Welding procedure for PE100 pipes

The following procedure is in accordance with the draft UNI 10520 standard and the "recommendation for the welding of PE100 pipes" SMP 74/97.
The welding must be carried out using a welding machine complete with:

- hydraulic control unit for the mechanical coupling of the flaps to be welded, with a manometer of suitable class to control the applied pressure;
- base consisting of two supports, one fixed and one mobile, sliding on guides, each equipped with two grips for clamping the pieces to be welded;
- plate thermoelement coated with non-stick material, with built-in electrical resistances and regulated by a calibrated thermostat;
- milling machine able to ensure the correct preparation of the flaps;
- automatic control system of the welding operations through:
    - the oleo dynamic control of the thrust elements and the welding plate;
    - the steering of the pressure values set for the various stages;
    - the government of the set times for the various stages;
    - The government of set temperatures.
- The recording and return on electronic support or paper of the parameters used for each single welding and their progressive numbering:
- the equipment used, in addition to compliance with the current legislation, will have to ensure:
    - correct alignment of the parts to be welded;
    - an adequate plan-parallelism of the surfaces to be welded;
    - The regulation and control of the welding parameters (pressure, temperature, time).

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The welding machine and other necessary equipment (thermoelement, milling machine) must ensure that the welding process is carried out properly and in accordance with the procedures described below.
The electrical power of the thermoelement must be sufficient to ensure that the required temperatures are reached under the permitted working conditions; it must also be ensured that at each point of the two surfaces of the thermoelement the temperature does not vary by more than ±5°C compared to the value set on the thermostat.
The thermoelement must be equipped with a thermometer with a measuring range suitable for the temperatures to be set.
When not in use, the thermoelement must be placed in a suitable container whose characteristics must be such as not to damage the surface coating of the thermoelement.
The welding device (welding machine) consists of an energy dispenser device that can be manual, semi-automatic or automatic, characterizing the various types of welding machines.
These devices regulate the amount of energy according to what is required by the electrical circuit incorporated in the electro welding element.
Each welding machine must be used only for the electro-weldable connections for which it has been enabled.
The characteristic of these welding machines is that the setting of the welding data takes place automatically, by means of barcodes, magnetic cards or equivalent systems.
In any case, these welding machines must be equipped with devices capable of both verifying the electrical resistance of the electro weldable fittings before welding and of automatically intervening for the interruption of the energy after welding.
The contact welding machine with thermal elements shall consist of a base (frame), two guiding elements and two carriages, one mobile and one fixed, on each of which at least 2 jaws shall be placed.
The pressure for the translation of the sliding carriage will be supplied by a power unit with pump and distributor with manual or electro-hydraulic operation.
Welding machines in which the translation of the clamps takes place by manual mechanical movement and the welding pressure is by means of springs are forbidden.
For the safety of the operator, the use of welding machines built in compliance with UNI 10566 is mandatory.
The welding must be carried out in as dry a place as possible: in cases of rain, high humidity, wind, excessive solar radiation, the welding area must be adequately protected with appropriate curtains; it is advisable to weld in an ambient temperature range between -5 °C and +40 °C.
It is not allowed to use hot gas torches or burners in direct contact with the surfaces to be welded to raise their temperature.
At the beginning of each working day, it is necessary to check the operating conditions of the available equipment (thermoelement, welding machine and milling machine).
It must be verified, by means of a calibrated digital thermometer, that the temperatures of both surfaces of the thermoelement, in the area to be welded, are within a tolerance of ±10 °C with respect to the value set on the thermostat.
Moreover, immediately before the start of the welding operations, it is recommended to make a test welded joint to verify the efficiency of the equipment system used.

3.6.1. Welder Verification

The welding personnel must have the following characteristics:

- have been previously trained, qualified and certified by the Contractor in accordance with the UNI 9737 standard;
- have been accepted by the Client: for this purpose, before the start of work, the Contractor will deliver to the Client the complete list of qualified welders who will be employed in the work;

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- if while the works, Agencies or Authorities require qualifications other than those possessed, they must be trained, at the Contractor's care and expense, to be adequate and qualified.

It is forbidden to put welders on the Jobsite without the Client's prior written approval and any welds carried out by welders not expressly accepted by the Client must be eliminated and re-performed, at the Contractor's care and expense, by welders approved by the Client.

3.7. Connecting with other materials

If it is necessary to join PE100RC pipes with other types of pipes (metal or plastic of a different nature), the use of adhesives or cement mortar will in any case be forbidden and the connection can be made by means of a flange connection.
The equipment therefore connected must be anchored to concrete blocks in a way that does not induce bending and/or torsional forces on adjacent structures.

3.8. Joints

3.8.1. Mechanical clamping coupling – Gilbault type

This type of joining may be applied to any type of pipe, even between pipes of different materials, if they have the same external diameter.
Whatever the external shape and type of clamping with which this joint is made, it is necessary that its useful length, i.e. the axial distance between the two seals, is not less than the sum of the maximum linear variations that can occur due to thermal effect in the two parts to be joined, plus a quantity varying from 30 to 100 millimetres in relation to the diameter of the parts themselves.
The joint must be made in the following order of operation:

- carefully clean the parts to be joined and ensure that they are intact;
- insert the ends of the two tubes into the mechanical joint and make sure that each tube is inserted at least 1/3 of the length of the sleeve, taking care, however, that they do not meet each other;
- insert the bolts, washers and nuts by tightening them crosswise.

3.8.2. Free flange coupling with collar support

This type of joint can also be made between pipes of different materials or for connection to special parts. It is made with sliding flanges inserted on weldable collars.
The flanges can be made of normal carbon steel or plasticized steel or any other material suitable for the purpose.
The joint must be made according to the following order of operations:

- thread the free flange into the end of the pipe;
- join the support collar to the pipe;
- place the elastomeric gasket in the appropriate groove of the collar;
- bolt by cross-fastening.

3.8.3. Expansion joint

Where provided, expansion joints of the "metal bellows" type will be adopted in accordance with the specifications set out in the technical drawings or according to the indications of the Site Manager,
If the use of such joints is not considered appropriate, the Sile Manager, as an alternative, will be authorized to block the longitudinal movements of the pipe by means of suitably localized and dimensioned anchors.

3.9. Laying gravity pipelines

3.9.1. Trench bottom

The trenches must be made without gutters or roughness, creating a continuous support for the pipe. If there is reason to be concerned about the instability of the ground, due to water detected in the

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trench, it is necessary to consolidate the bottom with the help of drainage pipes below the pipeline, placing a thick layer of gravel or other appropriate material around them; in other words, it is necessary to ensure that there is no possibility of any displacement of the backfill material due to the groundwater.

3.9.2. Laying bed

A stable, level-surfaced bed, free from gravel, stones and any other materials, must be provided for the pipelines.

The laying bed must not be formed before the trench bottom has been completely stabilised.

The material used under laying conditions is sand mixed with gravel with a maximum diameter of 20 mm.

In slopes, it is advisable to avoid sand by preferring gravel or crushed stone without cut edges with a maximum size of 10/15 mm.

The material must then be carefully compacted and reach a thickness of at least (10+1/10D) cm, taking care to respect the slope calculated in the design phase.

The bottom of the excavation must be made with material of a sufficiently fine grain size, so that there are no sharp edges in contact with the walls of the pipe.

Since the width of the excavation can be reduced, it is recommended not to excavate more than 1.50 times the external diameter of the pipe. Larger values may, of course, be adopted to allow the workers to use them to carefully arrange the bottom and the bed of laying and to carry out all the necessary operations for the realization of any joints and for the compaction of the backfill material. The walls of the excavation, especially in the part of the ground where the pipe is placed, must be as vertical as possible.

The filling of the excavation is the most delicate part of the installation and must be carried out by compacting in successive layers of about 30 cm. The compaction value is the one with Proctor density greater than 90 - 95%.

3.9.3. Backfilling basic procedures

Place the backfill material of the pipe area in layers on each side and compact according to the methods contained in the following paragraphs. Make sure to compact the material under the sides of the pipe.

The free fall of backfill material on the pipe centreline must be kept to a minimum.

The backfill above the pipe area must be spread in approximately uniform layers, if applicable, and compacted according to the following figure.

3.9.4. Backing in the pipe area

The encasement is mainly dependent on the annular rigidity, the height of the covering and the nature of the native soil. One of the most common methods used in practice for pipe installation is the encasing around the pipe made of the same material.

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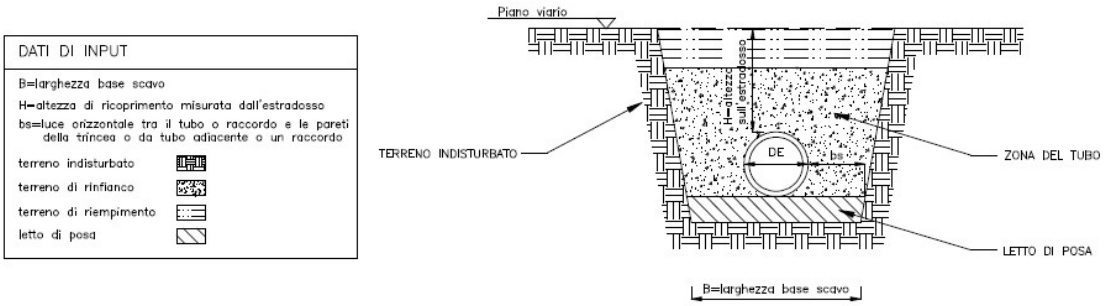
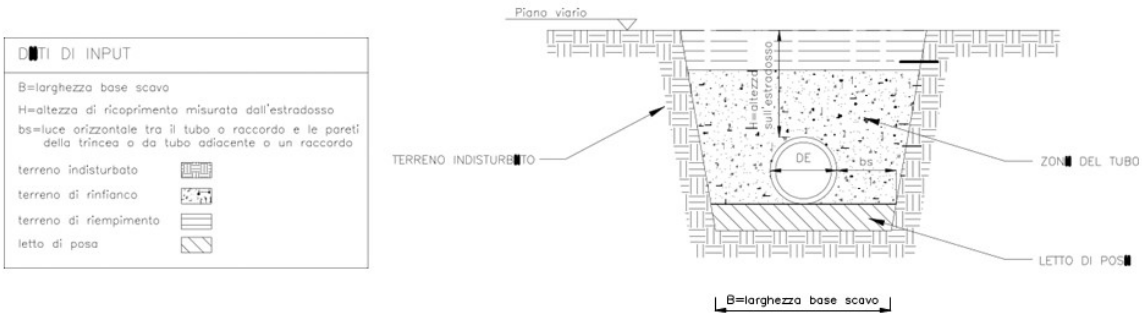


Another method that can be used for the installation of the pipes is the encasing made with two materials or different degrees of consolidation. In this case it is important that the level of separation between the lower and upper material is between 50% and 70% of the pipe diameter above the laying bed. This is to prevent the possibility of generating high stress/elongation at the separation level when the pipe deflects.



When imported material is used for the primary area the granular material used shall be well sorted with maximum particle sizes in accordance with the following table. When single particle size material is used it shall be ensured that the maximum particle sizes are smaller than those given in the table below.

Native soil may be used if it meets all the following criteria:

- without particles larger than the applicable limits given in the above table;
- without lumps twice the maximum particle size given in the above table;
- without frozen material;
- without debris (e.g. asphalt, bottles, pots, wood);
- when compaction is specified, the material must be compactable.

NOMINAL SIZE	MAXIMUM SIZE [mm]
DN < 100	15
100 < DN < 300	20
300 < DN < 600	30
DN > 600	40

NOTE: The values are those used in the sieve descriptor, e.g. 6/14, 8/12 etc.. It is accepted that in this sorting individual particles may be larger than the descriptor.

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The filling of the trench and the excavation in general is the basic operation of the installation. The uniformity of the soil is fundamental for the correct construction of a load-bearing structure, as the soil reacts to contribute to bearing the imposed load.

The bedding material is placed around the pipe and compacted by hand to form successive layers of 20 cm, up to the middle of the pipe, taking great care to ensure that no hollow areas remain under the pipe and that the backfill layer between the pipe and wall is continuous and compact.

The second backfill layer goes all the way to the pipe's upper generatrix.

It must always be compacted with the greatest care. The third layer is 15 cm above the upper part of the pipe.

Compaction should only take place on the side of the pipe, never above it.

The compaction of the filling covering the pipe must be uniform and reach 90% of the optimal value determined with the modified Proctor test.

Reinforcement with peaty, muddy, clayey, iced soils is forbidden as these soils are not compressible due to their high-water content.

The further filling is carried out with the material coming from the excavation, separated from the elements with a diameter greater than 10 cm and from the vegetal and animal fragments; it must be made for successive layers equal to 20 cm that must be compacted and possibly wet for the thickness of 1 m (measured by the upper pipe axis), so that the density of the soil in site reaches, after compaction, 90% of the optimal value determined with the modified Proctor test.

The coarsest material (pyetrich with a diameter > 2 cm) must not exceed the limit of 30%. Finally, a free space must be left for the last layer of plant soil.

Parallel pipe systems lying in the common trench must be placed far enough apart to allow the compaction machinery to compact the material in the pipe area between the pipes.

3.9.5. Compaction quality control

Compliance with the design assumptions shall be confirmed by one or more of the following methods:

- Continuous monitoring of backfill procedures;
- Verification of the initial deflection of the installed pipe;
- On-site verification of the degree of compaction with appropriate tests under dry and saturation conditions.

After repair or other connection procedures, it must be ensured that when replacing the backfill material both on the side and above has a density approximately equal to that immediately adjacent to the replaced area.
Its compaction must always be carried out with the utmost care. The third layer reaches 15 cm above the upper surface of the tube.
Compaction should only take place laterally to the side of the pipe, never on its vertical side.
The compaction of the filling covering the pipe must be uniform and reach 90% of the optimal value determined with the modified Proctor test.
Reinforcement with peaty, muddy, clayey, iced soils is prohibited because these soils are not compressible due to their high-water content.

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4. PRECAST REINFORCED CONCRETE ELEMENTS

This chapter outlines the technical specifications for the following precast concrete elements included in the project:

DESCRIPTION
SEWAGE SIFONATED MANHOLE
WASTEWATER MANHOLE
WASTEWATER MANHOLE WITH PLUGS
WOLTMANN SIFONATED METERING MANHOLE
SAMPLING MANHOLE
INSPECTION CHAMBER
STORMWATER MANHOLE
PRECAST CONCRETE CHANNEL
SYPHONATED STORM DRAIN
STORMWATER BARREL SYPHON MANHOLE
MANHOLE AT DOWNSPOUT BASE WITH CHECK VALVE
MANHOLE AT DOWNSPOUT BASE
SPILLWAY MANHOLE
FIRST-FLUSH IN BATCH TREATEMENT PLANT WITH DESANDING AND DEOILING
FIRST-FLUSH CONTINUOUS TREATEMENT PLANT WITH DESANDING AND DEOILING
PUMPING STATION
DISCHARGE TO ROGGIA CARIOLA

Prefabricated structure is a structure built by combining and/or completing several elements built in the plant or on site.

The design, execution and testing of prefabricated structures are regulated by the norms contained in the Decree of the Minister of Public Works of 3 December 1987, as well as in Circular no. 31104 of 16 March 1989, DM 14.01.2018 and any other dispositions on the subject.

Compliance certification of the prefabricated structures used and assembled by the Construction Company shall be in accordance with the indications contained in the Decree of the Ministry of Infrastructure dated 11 April 2007.

Prefabricated products in vibrated reinforced concrete must be produced by specialised manufacturers, in specific plants approved by the Site Manager, with production technology that guarantees the repeatability of the product and ensures the uniformity of the geometric and physical characteristics and the degree of compaction at each point of the product.

The prefabricated structures used and assembled by the Construction Company must belong to one of the two production categories provided for by the Ministerial Decree of 14.01.2018, namely: "declared" series or "controlled" series.

The materials for the preparation of concrete, semi-finished products and accessories for the prefabrication of manufactured products must comply with the laws currently in force and with the EEC and UNI regulations relating to the manufacture of individual products.

The prefabricated elements will have to withstand 1st category moving loads (according to the Ministerial Decree LLPP 4 May 1990).

The reinforcements must be made with double electrowelded mesh and additional shaped irons. It must be produced in compliance with UNI EN 14844:2009 (products with CE marking).

The structures must be free of through-holes and must be installed with suitable equipment approved in accordance with the regulations in force on site safety.

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The support base must consist of a concrete jet of the class and size as specified in the civil works calculation, including the burden of checking the level with the aid of suitable laser equipment.

The prefabricated structures must be made of vibrated reinforced concrete, specifically designed to be fitted with extension elements and manholes for heavy traffic, in resistance class Rck not less than 40 N/mm^2.

The elements must be made with half thickness interlocking, with lateral imprints for the insertion of the tubes.

The construction company is required to revise the internal dimension of the manholes in order that it is congruent and functional in compatibility with the pipes/culvert diameters and any special parts.

4.1. Unions and joints

By "unions" we mean connections between structural parts suitable for the transmission of stresses. By "joints" we mean spaces between structural parts suitable to allow them to move mortgages without transmitting stresses.

The materials used with structural function in the unions must have, as a rule, a durability, fire resistance and protection, at least equal to that of the elements to be connected. If these conditions are not met, the limits of the entire structure must be defined with regard to the weaker significant element.

Joints with facing surfaces must guarantee adequate spacing of the surfaces to allow predictable movements.

The Site Manager must verify that any finishing work does not affect the free operation of the joint.

The joint between the elements must only be made using hydraulic or manual TIR-FOR equipment, ensuring the correct positioning of the gasket seal.

The junction system must be of the interlocking type according to ASTM C-789, perfectly smooth in the male and female elements, with no steps and/or re-segades, in order to allow the perfect positioning of the butyl gasket, according to ASTM C-990, which during the crushing phase will be squeezed in such a way as to completely fill the voids between the joints, thus ensuring the hydraulic seal. The following table shows the physical properties of the gasket.

	Spec.	Requisiti	CS-102	CS-202
Miscela di idrocarburi in % in peso	ASTM D4	50% min.	51%	52%
% di carica inerte minerale in peso	AASHTO T111	30% min.	35%	35%
% sostanze volatili in peso	ASTM D6	2% max	1,2	1,2
Peso specifico a 77° F	ASTM D71	1.15-1.50	1.25	1.20
Duttilità a 77° F	ASTM D113	5.0 min.	10	12
Penetrazione cono a 77°F 150 gm 5 sec.	ASTM D217	50-100	55-60	60-65
Penetrazione cono a 32°F 150 gm 5 sec.	ASTM D217	40 mm	40-45	50-55
Punto di infiammabilità C.O.C. °F	ASTM D92	350°F min.	450°F	425°F
Punto di incendio C.O.C. °F	ASTM D92	375°F min.	475°F	450°F

4.2. Acceptance

All deliveries of structural components produced in a controlled series can be accepted without further material checks, or load tests of the insulated components, if accompanied by a certificate of origin signed by the manufacturer and the technician responsible for production and certifying that the elements have been series products controlled and enclosing a copy of the relative extract of the production register and of the details of the certificates of preventive verification of the official

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laboratory. For declared mass-produced structural components, a declaration of conformity issued by the manufacturer must be verified.

4.3. Installation

When laying and adjusting the prefabricated elements, the necessary measures must be adopted to reduce the stresses of a dynamic nature due to the movement of the elements and to avoid strong stress concentrations.
The adjustment devices must allow compliance with the tolerances provided for in the project, considering both those of production of the prefabricated elements, and those of execution of the union.
Any constraint devices used during the laying, if left permanently on site, must not alter the correct functioning of the joint made and, in any case, generate stress concentrations.

In compliance with the current accident prevention regulations, the lifting equipment must be proportionate for the maximum performance foreseen in the assembly program; moreover, during the installation phase of the prefabricated element up to the contact with the supports, the means must have a laying speed commensurate with the characteristics of the supporting surface and with that of the element itself. The descent speed must be such that the dynamic impact forces cannot be considered influential.
The elements must be positioned as and were indicated in the project.
In the presence of integrative jets made in situ, which contribute to the stability of the structure even in the intermediate phases, the assembly program will be conditioned by the maturation times required for these, according to the project requirements.
The element can be released from the installation device only after its stability has been ensured.
The element must be stable in the face of the action of:

- own weight;
- wind;
- actions of subsequent assembly operations;
- conventional horizontal actions.

The equipment used to guarantee stability in the transitory phase that precedes the final completion of the work must be equipped with equipment, where necessary, to allow, in conditions of safety, the operations of recording the element (small displacements of the three coordinates, small rotations, etc.) and, after the final fixing of the elements, the recovery operations of the equipment itself, without causing damage to the elements themselves.
An assembly order must be foreseen in the project to avoid the creation of structures that are temporarily labile or unstable.
The correspondence of the artifacts to the project under all the aspects detectable to the assembly (shapes, dimensions and relative tolerances) will be subjected to verification by the Su, which will exclude the use of non-responsive products.

4.4. Precast manholes

This chapter outlines the technical specifications for the following precast concrete stormwater manholes included in the project:

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DESCRIPTION
STORMWATER MANHOLE
SYPHONATED STORM DRAIN
STORMWATER BARREL SYPHON MANHOLE
MANHOLE AT DOWNSPOUT BASE WITH CHECK VALVE
MANHOLE AT DOWNSPOUT BASE
SPILLWAY MANHOLE

And for the following wastewater manholes included in the project:

DESCRIPTION
SEWAGE SIFONATED MANHOLE
WASTEWATER MANHOLE
WASTEWATER MANHOLE WITH PLUGS
WOLTMANN SIFONATED METERING MANHOLE
SAMPLING MANHOLE
INSPECTION CHAMBER

Supply and installation of a monolithic inspection manhole with perfect self-supporting hydraulic seal, including the costs for the preparation of the lean concrete support base, the backfills in loose material, the connection of the pipes, the costs of transport, loading, unloading, handling, hydraulic control and any other costs necessary for the construction of a fully functional and hydraulically sealed manhole without the use of sealants or grouting of the main joints and any connections.
The inspection manhole must be made of vibrated and reinforced concrete, sized for 1st category loads. The manhole will be made of the following elements: base, rings and monolithic elements for raising to height as specified in the project complete of reduction and extension element up to the diameter for the installation of the manhole cover required for the walking step.
The rings must be manufactured in a precast plant as follows:

- preparation of the metal reinforcement;
- the mouldings are made, one inside and one outside, in calendared metal plates and placed vertically;
- casting the concrete within the vertical walls using a metal guide for simultaneous casting at every point of the ring;
- steam drying of the concrete;
- opening the mouldings and removing the ring;
- lifting the ring by means of a metal trellis to allow the three ropes, one for each bushing, to remain vertical;
- storage of the rings for about a week to fully meet the resistances.

The extension designed for the wastewater manholes, inspection stormwater manholes, junction manholes and connection manholes, etc., will be compliant with the European standard UNI EN 1917. Extension elements of variable size (manhole risers) will allow the adaptation to the road level. Everything will be made with prefabricated elements of vibro-compressed concrete mix in resistance class Rck not less than 40 N/mm^2.
The rings must contain four 60 mm membranes injected with expansive cement mortar, such as EMACO or similar, only after a 20 mm steel bar has been inserted, to solidify the various rings and make the chamber monolithic.
The cover is made of a prefabricated reinforced concrete plate, positioned as a cover to close the rings and can be removed when an extraordinary intervention inside the manhole is necessary. A manhole with a carriage walking step 60 cover of spheroidal cast iron is required. In the lower part

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of the cover needs to be embedded metal plates to allow the sliding guide of the work hoist, which is necessary for lifting the valves and equipment placed at the bottom of the manhole.

The plastic sealing gasket, made of synthetic rubber, must be embedded in the manhole riser section when casting it. The gasket cross-section must guarantee perfect anchorage with the concrete and have a contact area of not less than 10 cm^2. The rubber quality of the gaskets must comply with UNI EN 681-1 and DIN 4060 standards.
The dimensional tolerances, checked and recorded in the production plant, referring to the circularity of the male and female element of the manhole and to the connection's holes for the main pipes, must be between 1-2 ‰ of the nominal dimensions in order to obtain a correct compression of the rubber gasket for a perfect hydraulic seal.
For the internal dimensions of the manholes, reference is made to the project drawings.
The contractor is required to check the internal dimension of the manholes in order that it is congruent and functional with the diameters of the pipes and any special items.
The supplier company is required to transmit all certificates and structural stability calculations, signed by engineer registered to the Engineer's Order.

The wastewater sewerage includes inspection manholes, siphon manholes, flushing manhole for building connections, sampling manholes, flushing manholes.
The walls of the manholes must be treated with an epoxy resin sealing coating having the following characteristics:

- a high strength Portland cement-based coatings with quartz and other micronized inorganic chemicals with stabilization and water repellence function;
- must be applied to wet walls with a paddle or brush;
- must be a coating that is resistant to aggressive agents in the soil and constitute a valid and durable protection for the concrete, with a high mechanical resistance.

The sealing coating must be applied to the outer surfaces of the rings including the flaps and side walls of the foundations as well as to the inner tine of the first ring on the foundation plane.
The joints between ring and ring for the underground part must be sealed by means of a plastic cast joint.
After having spread a coat of primer by a brush on the surface of the joint to be sealed, wait for the film to dry completely and then proceed with the installation of the joint.
It must be a two-component sealant product based on polysulphide that by chemical reaction between the two components hardens into a solid and elastic material with negligible shrinkage.
It should be noted that the joint to be sealed is a recovery joint and not a working joint, so as it is not subject to continuous movement it must guarantee a perfect seal.

The rings are placed one on top of each other, taking care to match the gaskets embedded in the rings, an indispensable operation to be able to insert the steel bars and then to perform the anchoring with expansive mortar.
Reference standards:

- UNI EN 681-1 Elastomeric sealing elements - Materials requirements for pipe joint seals used for water supply and drainage - Vulcanized rubber - UNI 8981 Durability of concrete structures and precast concrete elements;
- UNI 9858 Concrete, performance, production, installation and conformity criteria - DM 12.12.85 Technical standards for pipes. LLPP Circ.LLPP 27291 Instructions on the regulations for pipes;
- DIN 4034 Schächte aus Beton-und Stahlbetonfertigteilen;
- DIN 4033 Wastewater channels and pipes with prefabricated pipes. Construction Directives;
- ATV A127 Guideline for the static analysis of sewage channels and pipelines;

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- pr EN 1917 Inspection rooms and manholes in reinforced and unreinforced concrete, fibre-reinforced.

The inspection manholes for the stormwater drainage system will be positioned as drawings and will be equipped with a spheroidal cast iron cover with resistance class D400 (breaking load greater than 40 t), meshed, measures in accordance l and the specifications of the design drawings, must comply with the UNI EN 124 standard.

4.5. Precast channels

This chapter outlines the technical specifications for the following precast concrete elements included in the project:

DESCRIPTION
PRECAST CONCRETE CHANNEL

For the installation and acceptance of each precast channel follow the general precast elements specification.

Refer to the design drawings and reports for all dimensions.

The site manager may propose different external dimensions, provided that the invert levels at the top and bottom are respected as shown in the project drawings and the drainage cross-section.

At the end of each of the channels in the project, there will be a special drainage piece. If the drainage pipe is parallel to the channel, it will be a bottom hole, and if the drainage pipe is perpendicular to the channel, it will be a bottom manhole of the same size as the channel.

The site manager may propose special drainage pieces for the channels in the project that differ from those proposed, provided they are compatible with the drainage pipes in the project.

4.6. Precast tanks

This chapter outlines the technical specifications for the following precast concrete elements included in the project:

DESCRIPTION
FIRST FLUSH IN BATCH TREATEMENT PLANT WITH DESANDING AND DEOILING
FIRST-FLUSH CONTINUOUS TREATEMENT PLANT WITH DESANDING AND DEOILING
PUMPING STATION

Each of the constituent elements of the prefabricated tanks must comply with the requirements set forth by the current regulations, namely: Law 1086/71, Law 64/74, DM 17.01.2018, and must be made with CE certified materials, with concrete of a compressive strength class of C45/55 in compliance with the provisions of the UNI EN 206-1 and UNI 11104 standards for the exposure classes XC4 (resistant to corrosion induced by carbonation), Cd3-CS3 (resistant to corrosion induced by chlorides), XF1 (resistant to freeze/thaw cycles with or without de-icing salts), XA2 (resistant to aggressive chemical environments in natural soil and groundwater), internal reinforcement with steel bars for adhesion, and welded mesh with square grid of type B450C.

The presence of at least 2 persons is required for hooking, unhooking and positioning the material, equipped with ladders and PPE. The transit and manoeuvring areas must be adequately stabilised on level ground and suitable to allow accessibility from the vehicle. On the arrival of the vehicle, the Contractor must indicate the positioning area and coordinate the unloading of material.

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The Contractor will provide a calculation report, a SPECIFIC structural table for seismic deposition signed by a qualified technician and drawn up since the laying conditions and the geotechnical geological report.

Photometry is included as per the graphic drawings. The Contractor must check the photometry and its location in the project drawings and in the event of inconsistencies must inform the Site Manager before execution of the work.

The Contractor may propose to cast the tank on site if it maintains the same structural, hydraulic, performance and functional characteristics.

For the laying, installation, and excavation of each of the elements of the prefabricated tanks in the project, the following procedure should be followed:

- perform the excavation increased by 50/100 cm compared to the footprint of the structure;
- create a lean concrete slab (cleaning pour) of 5/10 cm thickness;
- create a foundation slab in reinforced concrete (RC) of 20 cm thickness, reinforced with double welded wire mesh Ø8 with a 20x20 cm grid;
- create a sand bedding layer (settling layer) with a minimum thickness of 5 cm;
- after placing the structures, backfill with inert fill material A1-A3;
- apply cement mortar/polyurethane foam over the walls for the subsequent installation of the cover or possible extension.

For the preparation of the bedding layer for each of the tanks in the project, follow the following procedure:

- perform the excavation, increasing it by 50/100 cm on each side compared to the dimensions of the structure;
- create a cleaning pour in lean concrete with a thickness of 5/10 cm;
- create a concrete slab with a thickness of 20 cm, reinforced with double welded wire mesh Ø8 M 20x20 cm, properly levelled;
- create a sand bedding layer with a thickness of 5 cm, properly compacted.

For the proper sealing of the connection pipes to the tanks, follow the following procedure:

- clean the pipe;
- apply a layer of epoxy adhesive, such as EPORIP (Mapei) to the pipe and while still fresh, pass it through quartz sand to achieve a 'sandpaper-like' effect;
- Once the pipe is completely dry, insert it into the hole of the structure and proceed with sealing the holes using MAPEGROUT (Mapei), excluding the last 2 cm from both the internal and external sides of the structure;
- Once the Mapegrout has dried, complete the sealing with a two-component epoxy resin, such as ADESILEX PG2 (Mapei), ensuring perfect alignment between the pipe and the wall, and also creating a fillet;
- Before encountering water, ensure that the sealant is completely dry.

Refer to the design drawings and reports for all dimensions.

Each of the tanks in the project will be topped with a cover resistant to heavy traffic. Refer to the design drawings for all dimensions.

For the installation of each manhole riser positioned above the tanks (relate to drawings) follow the manhole installation and acceptance procedure.

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4.7. First flush in batch stormwater treatment plant (SPP.FFT)

The treatment plants described in the design schemes consist of the following sections:

- first flush rainwater spillway: designed to separate the first flush, more polluted waters from the following, which can be discharged directly to the final receptor;
- Storage tank, designed to retain the entire volume of water corresponding to the "first flush";
- oil and gasoline separation tank, equipped to facilitate the flotation of oils and their subsequent collection;
- anti-spillway valve check design for gas station use.

The spillway manhole has a single inlet pipe, suitably sized, and two outlet pipes, arranged at different heights to facilitate the water's flow in two successive and distinct moments.
The first pipe through which first rainwater flush will flow is the one positioned lower than the others in the manhole, and it is also the one that will lead to the treatment system.

The “first flush rainwater” then flows to the storage tank, when the "maximum level" condition is reached the flow inlet to the storage tank is interrupted by a non-return valve.
The overflowing water, otherwise known as "second flush rainwater", can now flow directly to the final receptor, using the overflow line that bypasses the entire treatment system and takes it directly to the discharge.
Once the precipitation event has ended, the "first flush rainwater" discharge device can be activated. This device consists of a rain sensor, that will establish the beginning and the end of atmospheric precipitation and will start a special submersible electric pump located inside the storage tank.
The purpose of the submersible electric pump is to allow the gradual discharge of "first flush rainwater”, flowing into the de-oiling section at a constant flow rate, within 96 hours of the end of the meteoric event.
This automatic mechanism is managed by a timer installed in the automation and control General Electric panel.

The steady running of the submersible electric pump over the 96 hours following the meteoric event will ensure a regular running of the de-oiling section, preventing the formation of turbulence, dangerous for the separation of oils and floating substances from water.
The oil separator is equipped with a coalescence filter, whose function is to obtain the separation of floating substances (density not exceeding 950 gr/litre) from water by simple flotation, and to increase the separation efficiency of the oil separator, which must ensure the reductions required by DIN 1999 - N.E. 858 / I and II standards.
The coalescence filter allows, therefore, the implementation of the physical phenomena of absorption and coalescence.
In practice the micro-particles of oil adhering to the coalescent material (absorption), joining to each other will grow into large particles or drops (coalescence). When it reaches a certain volume the drop of oil will become unstable, so it will separate and due to the different specific weight compared to water, it will rise to the surface.
Treatment Guarantee:

Legislative Decree 152/06 Part Three, Annex 5, Table 3 "Discharge to Surface Waters", provided that the qualitative and dimensional values of inflow to the treatment itself are respected and guaranteed, limited to the parameters of suspended solids, oils and non-emulsified hydrocarbons.

4.8. First flush continuous treatment plant (SAO.FFT)

The project includes the application of two first flush continuously treatments sized in compliance with the EN 858 standards, for the control of hydrocarbons and suspended solids present in the first fraction of rainwater.

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Because of the large areas draining to each plant, it was decided to use continues smaller treatment plants distributed in the points that guarantee greater control and supervision of the network, especially in the event of spills.

The installation of the sand traps / oil separators, with continuous operation at the service of the street and yards runoff.

The continuous rainfall plant has a UNI EN ISO 9001 and ISO 45001 management system. It is made of vibrated reinforced concrete monobloc reinforced with vertical pillars and horizontal stainless steel struts, with protective elastomeric anti-cracking paint on the outer concrete walls with high permanent elasticity and high chemical resistance, concrete of compressive strength class C45/55 (RCK>55 N/mm2), internal reinforcements of factory-controlled improved adhesion steel and B450C type square-meshed electro welded mesh, with chemical resistance and fire reaction certification (Class A1) issued by an external body in accordance with UNI EN standards.

Each continuous first rainfall system consists of:

- first rainfall tank (sand trap-de-oiling) - refer to the design drawings and reports for all dimensions - a supplied complete with: inlet/outlet hole; AISI 304 stainless steel deflector at the inlet; de-sanding compartment; internal separation baffle in reinforced concrete with passage hole and AISI 304 stainless steel deflector at the desander outlet; de-sanding compartment complete with coalescence filter in removable and washable AISI 304 stainless steel frame and automatic closure device of the float shutter type made entirely of AISI 304 stainless steel and conforming to standard UNI EN 858-1.

Treatment Guarantee from the treatment system:

- Legislative Decree 152/06 Part Three, Annex 5, Table 3 "Discharge to Surface Waters", provided that the qualitative and dimensional values of inflow to the treatment itself are respected and guaranteed, limited to the parameters of suspended solids, oils and non-emulsified hydrocarbons.

4.9. Stormwater pumping station (DTn.S1)

Two pumping stations with an emergency function are connected to the planned detention tanks and features both a bottom inlet and an elevated overflow inlet. The bottom inlet will be manually activated in the event of flooding of the retention structure and has an inlet sluice-gate with the following characteristics:

- wall-mounted, square guillotine sluice gate made of AISI 304 stainless steel in compact design with four-sides sealing in both flow direction for use of surface water, sewage and aggressive environments in accordance with DIN 19569-4, pf AISI 304 stainless steel, EPDM seal, actuation by means of a non-salient stainless-steel screw, stem nut made of seawater-resistant bronze. Shield dimensions to be defined connected with a stainless-steel chain that allows manual opening.

All electromechanical equipment of the pumping station must have redundancy both mechanically and electrically, to have a completely independent backup pumping system in terms of operation compared to the main pumping system.

The minimum electromechanical equipment to be provided inside the pump suction chamber and the valve chamber are as follows (for each of the two systems):

- two couples of electric pumps for charged liquids, with operating points: flow rate Q1 = 14l/s, Q2=16 l/s; pressure drop to be defined;

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- flanged ball check valve PN16 DN to be defined;
- five meters length of stainless steel chain;
- 2 sewage float switch;
- spheroidal cast iron gate valve with rubberised wdge PN16 DN to be defined;
- motorised inverter start-up panel;
- steel bottom plate.

The submersible pumps for dirty liquids have the following technical specifications:

- design flowrate: Q1 = 14 l/s, Q2 = 16 l/s
- design piezometric head: to be defined,
- maximum head: to be defined,
- maximum solid content: 4%,
- nominal Power: to be defined,
- nominal frequency: 50 Hz,
- nominal voltage: 400 V,
- nominal current: 11.9 A,
- number of poles: 4,
- protection degree: IP68.

The final pump selection will be carried out in the subsequent design stage, after the project elevations are fixed and the invert levels along the discharge line and the receiving channel are surveyed and confirmed.

The dimensions of the manhole risers for the extraction of the pumping systems will be sized according to the technical specifications of the manufacturer of the selected pumping system. If the project manager decides to modify the electromechanical equipment, the dimensions of the prefabricated concrete tanks must also be modified accordingly. Provided that the flow rate and the piezometric head at the design operating point are maintained.

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5. HYDRAULIC ITEMS AND SPECIAL COMPONENTS

5.1. Square cast-iron inspection manhole covers and grids

The table below lists the manhole types for which cast-iron inspection covers are required; refer to the project drawings for cover dimensions.

DESCRIPTION
SEWAGE SIFONATED MANHOLE
WASTEWATER MANHOLE
WASTEWATER MANHOLE WITH PLUGS
WOLTMANN SIFONATED METERING MANHOLE
SAMPLING MANHOLE
INSPECTION CHAMBER
STORMWATER MANHOLE
SYPHONATED STORM DRAIN
STORMWATER BARREL SYPHON MANHOLE
MANHOLE AT DOWNSPOUT BASE WITH CHECK VALVE
MANHOLE AT DOWNSPOUT BASE
SPILLWAY MANHOLE

The following table lists grid types for which cast-iron grids are required; refer to the project drawings for cover dimensions.

DESCRIPTION
PRECAST CONCRETE CHANNEL
SYPHONATED STORM DRAIN

5.1.1. Sewage network

Unless otherwise specified, manholes in spheroidal cast iron will be used to cover the access towers to the prefabricated manholes.

The dimensions and characteristics of the manholes shall meet the requirements of Standard UNI EN 124, for class D 400, in any installation situation.

Lids and frames shall be suitably lathe-ground, have smooth supporting surfaces and be suitably shaped to prevent the lids from rolling and slipping off. The cover shall be provided with two holes for lifting the cover with suitable equipment.

The manhole covers shall bear the following markings in the casting: UNI EN 124, corresponding class, name and/or initials of the manufacturer and any initials requested by the contracting station.

The seat of the frame and the height of the cover shall be calibrated so that the two elements are on the same plane and no play remains between them.

The upper surface of the manhole cover shall be perfectly level with the road surface after installation.

If, due to settling under load or resurfacing of the road during the works, the position of the frame does not guarantee absolute coplanarity between the manhole and the road pavement, the frame shall be removed and repositioned in the correct position.

Manholes shall not be subjected to traffic until 24 hours after their installation.

For manholes cast in situ, manholes UNI EN 124 class D400 are envisaged, characterised by the dimensions shown in the design drawings.

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5.1.2. Stormwater network

Unless otherwise specified, manholes in spheroidal cast iron will be used to cover the access towers to the prefabricated manholes.

The dimensions and characteristics of the manholes shall meet the requirements of Standard UNI EN 124, for class D 400, in any installation situation.

Lids and frames shall be suitably lathe-ground, have smooth supporting surfaces and be suitably shaped to prevent the lids from rolling and slipping off. The cover shall be provided with two holes for lifting the cover with suitable equipment.

The manholes shall bear the following markings in the casting: UNI EN 124, corresponding class, name and/or initials of the manufacturer and any initials requested by the contracting station.

The seat of the frame and the height of the cover shall be calibrated so that the two elements are on the same plane and no play remains between them.

The upper surface of the manhole cover must be perfectly level with the road surface after installation.

If, due to settling under load or resurfacing of the road during the works, the position of the frame does not guarantee absolute coplanarity between the manhole and the road surface, the frame shall be removed and repositioned in the correct position.

Manholes shall not be subjected to traffic until 24 hours after their installation.

For manholes cast in situ, manholes UNI EN 124 class D400 are envisaged, characterised by the dimensions shown in the design drawings.

In the specific case of precast concrete channels, the grates must be bolted to the concrete elements using M10 bolts.

5.2. Clapet check valves

The project includes the installation of Clapet-type backflow preventers to protect against backflow from the public sewerage system, detention tanks and the receiving water body in the following items:

DESCRIPTION
SPILLWAY MANHOLE
DISCHARGE TO ROGGIA CARIOLA

The gaskets to be interposed between the PN 10 coupling flanges shall be made of rubber with cloth impression and two inserted plies; the minimum overall thickness of each gasket shall be mm.4, with a hardness of 70 degrees shore type A - UNI 4916.

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The valve gaskets must be of a special material and conformation such as to be durably resistant under the envisaged environmental conditions.

The Contractor may propose different Clapet anti-flooding valve technologies to the Site Manager if they guarantee similar performance.cl

The Customer reserves the right to check, by means of Specialised Laboratories, the quality of the materials installed, by having the gasket and valve whose characteristics have not been authorised in advance replaced: the costs of such replacements will be at the Contractor's total expense.

5.3. Two-way throttle valve

In the project are provided at the downspout base manhole of the two-way throttle valve in the following item:

DESCRIPTION
MANHOLE AT DOWNSPOUT BASE WITH CHECK VALVE

with the following characteristics:

- butterfly Valve, 2-way, DN to be defined, Flanges with Models, Lug PN 16, ps 1600 kPa, kvs 1300 m³/h, kvmax 4200 m³/h, Fluid temperature -20...120°C [-4.0...248°F];
- position indicator and pin adapter, F07, square 45° offset, SW 17, DN 125...300;
- rotary actuator, 160 Nm (parameterised for D6250W/WL) (parameterised for D6250W/WL), AC 24...240 V / DC 24...125 V, On/Off, 3-point, 35 s, 2x SPDT, IP66/67, Terminals;
- rotary actuator with safety function NC / NO, 160 Nm (parameterised for D6250W/WL) (parameterised for D6250W/WL), AC 24...240 V / DC 24...125 V, BACnet MS/TP, Modbus RTU, MP-Bus, 2...10 V, 35 s (30...120 s), 2x SPDT, IP66/67, Terminals.

5.4. Bends, tee diameter reductions and plugs for hdpe pipes

This chapter outlines the technical specifications for the following elements included in the project:

DESCRIPTION
SEWAGE SIFONATED MANHOLE
WASTEWATER MANHOLE WITH PLUGS
INSPECTION CHAMBER

To make bends, diameter reductions, flanged tees, plugs, inlets, sleeves, etc., special PEAD PE100 parts are provided.

Special pieces in PEAD PE100 shall be provided along the route of the PEAD pipes, either pre-formed in the factory or moulded, weldable by electro-fusion or butt welding, produced by a company operating with an ISO 9001 certified quality system issued by an accredited body and in possession of Environmental Management System certification in compliance with UNI EN ISO 14001.

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The fittings shall be manufactured in compliance with the current regulations governing the transport of fluids, including UNI EN 12201 and UNI EN 1555.

The supplier's laboratory shall be equipped with all necessary equipment to ensure effective quality control of raw materials and finished products, in compliance with the main European regulatory standards, according to which the fittings are tested.

The fittings and special pieces shall be produced using certified Polyethylene, conforming to current European standards, classified: MRS 10 = PE100 = Sigma 80 produced by world-leading PE production companies.

The fittings produced shall be compatible and may therefore be joined with PE100RC pipes by butt welding with a thermal contact element (UNI 10520) or by electrofusion welding (UNI 10521).

These fittings shall be made by injection moulding, by assembly, in which case welding shall be carried out by Specialised Personnel with a Qualification Certificate in accordance with UNI 9737, or by machining.

Electro-weldable fittings shall be approved for nominal pressures of 16 bar, although they shall be coupled with PN 10 piping.

Each item, appropriately packaged and sealed until use, must be marked in accordance with EN 12201 and EN 1555 with the bar code for reading with an optical pen, the nominal diameter, melting time and cooling time, as well as the diameter, type of material, production batch number and certification standards and marks: the success of an electrofusion joint depends on compliance with the procedures and the correct use of alignment and positioning devices.

The Contractor may propose to the Site Manager different technologies of special parts for the pipes in question if they guarantee similar performance, for example, siphoned special pieces can be welded on-site starting from elbows and plugs, or they can be welded in the factory and delivered to the construction site as a single piece. For example, siphoned special pieces can be welded on-site starting from elbows and plugs, or they can be welded in the factory and delivered to the construction site as a single piece.

The main special pieces present in the project are: 90° elbow, 45° elbow, plug, 45° tee, 90° tee, and reduction (also shown in the following images).

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5.5. Woltmann metering

In the project, at the final section of the industrial drains and first flush drains, located within the cadastral area but outside the project boundary fence, two special manholes are present, within which a Woltmann type flow meter is installed.

The installation of a Woltmann meter is planned with the following specifications for measuring industrial flow rates:

- Woltmann axial cold water meter for industrial use in stainless steel including bolting to franges at pipe ends, glass sight and sealed clockworks (IP-68) nominal diameter to be defined.

And a Woltmann meter with the following specifications for measuring first flush flow rates:

- Woltmann axial cold water meter for industrial use in stainless steel including bolting to franges at pipe ends, glass sight and sealed clockworks (IP-68) nominal diameter to be defined.

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6. BANK PROTECTION IN NATURAL BOULDERS

This chapter outlines the technical specifications for the following elements included in the project:

DESCRIPTION
DISCHARGE TO CORIOLA DITCH

The natural boulders used for the construction of the bank protection works must meet the essential requirements of compactness, homogeneity and durability; they must also be free of joints, fractures and offset planes and comply with the following limits:

- bulk weight: > 24 kN/m^3;
- compressive strength: > 50 N/mm^2;
- wear coefficient: < 1.5 mm;
- imbibition coefficient: < 5%;
- frost resistance: the material must be non-freezing.

The natural boulders shall weigh between 100 and 300 kg, with an average diameter D50 of the boulder greater than 35 cm. The boulders must be sharp-edged and square.

The boulders to be used must be supplied along the front of the work; the picking up and transport of the material to the place of use must be carried out without causing any damage to the banks and the valuable vegetation. The material must be placed with the use of planks or slides, capable of protecting the hydraulic works: the rolling of boulders along the banks is strictly forbidden.

For works carried out in the absence of water, in watercourses subject to dry conditions, or, in lean conditions, with water levels below 0.50 m, the berm will be built within a foundation excavation close to the trapezoidal shape.

The boulders are to be placed in place one at a time, so that they are stable and not swaying, and so that the tightness of the berm in the position furthest from the bank is ensured by a large boulder.

If the work is to be carried out below the surface of the water, the boulders will be placed in bulk in a foundation trench of the prescribed dimensions, while checking the stability of the work.

The embankment is to be built starting from the foot and proceeding upwards. The slopes must be shaped and trimmed in advance to the prescribed slope and height for the necessary thickness below the profile to be laid when the covering is complete.

Prior to the laying of the boulders, the anti-slope geotextile must be installed, then the soil must be spread to a thickness of approximately 10 cm, and the boulders must then be placed.

Each element must be laid in such a way that the laying is stable and does not oscillate, regardless of the laying of adjacent elements; the joints must be staggered both longitudinally and transversally and must be such as to ensure close contact of the elements with each other without the use of flakes or fragments.

The elements constituting the verges will be carefully chosen and appropriately worked with a hammer, in order to obtain an exact profiling of the verges.

During the laying of the boulders, the interstices will have to be entirely filled with soil in order to create a blockage.

Particular attention must be paid to the fair-faced arrangement of the facing on the Canal side, so that it takes on the appearance of a rough mosaic, with no large voids or continuity solutions.

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The Contractor must guarantee that the hydraulic section of the Bassette Canal where the bank protection is realised is unchanged compared to the actual state.

As shown in the design drawings, the bank protection in correspondence with the Bassette Canal will be realised both on the left and on the right bank.

For the realisation of the bank protection in boulders foreseen on the left hydrographical bank at the Bassette Canal, the service road along the existing towpath, currently used by the Consortium for management activities and in good maintenance condition, will be used.

Before being laid, the material constituting the defence must be accepted by the Works Management, which will draw up a special report for each inspection.

At least one acceptance check must be carried out for every hundred linear metres of defence to be built: the result of this check will be binding for the acceptance of the batch relating to the said section of the works.

The check will consist in the identification by the Works Management, in its unquestionable judgement, of at least 20% of the boulders that must be individually weighed.

The consignment will not be accepted if the weight of a single verified boulder is lower than the minimum weight envisaged in the project.

If the verification is positive, samples will be taken and sent to an official laboratory for tests to determine the physical and mechanical characteristics of the material to be laid.

Tests relating to the determination of the physical characteristics of natural stones (determination of specific weight, imbibition coefficient and frost resistance) will be carried out, at the expense of the Contractor, according to Chapter II of the "Standards for the acceptance of natural building stones" as per Royal Decree no. 2232 of 16 November 1939; for tests of mechanical resistance (resistance to compression and wear due to sliding friction), reference will be made to Chapter III of the same regulations.

The Contractor shall deliver to the Works Management the certificates of the official laboratory relating to the above tests, which shall demonstrate compliance with the limits imposed by these specifications. If the results of the measurements or laboratory tests do not comply with the prescribed limits, the material, for the section under inspection, shall be rejected at the total expense of the Firm.All charges arising from the need to perform acceptance tests shall be borne by the Contractor.

The geotextile, with separation and filtration function, shall be made of 100 per cent UV-stabilised high-tenacity virgin polypropylene fibres, mechanically bonded by needle punching, free of chemical or thermal treatments.

The geotextile shall be CE and PDO marked in accordance with EN 13257, EN 13252.

The material shall also possess: total chemical inertia, rot-proof, rodent and micro-organism resistant, insensitive to weathering and brackish water, stability to ultraviolet rays obtained by means of suitable amounts of carbon black.

The technical characteristics of the material shall meet the following minimum requirements:

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PARAMETER	REFERENCE STANDARD	REFERENCE VALUE
Geotextile polymer	-	polypropylene
Unit mass	EN ISO 9864	> 300 g/m2
Thickness at 20 kPa	ISO 9863-1	2,0 mm
Transverse tensile strength	ISO 10319	24,0 kN /m
Elongation at transverse break		80 %
Longitudinal tensile strength		21,6 kN/m
Elongation at longitudinal break		80 %
Static punching (CBR)	EN ISO 12236	3.700 N

The material shall be supplied, packaged, in rolls no less than 6 metres wide.

The supplier must operate with a Quality System complying with the requirements of UNI EN ISO 9001 or 9002.

The supplier of the draining geo-net must carry out the checks on the characteristics of the sheets for each homogeneous batch produced and provide the relevant certificates to the Customer in original.

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